

CLAIMS

1. A water regeneration method for discharging ice condensed in a portion cooled by a cryogenic refrigerator installed in a case to an outside of the case, comprising:

5 a temperature increasing step for melting the ice;
 a vaporizing step for vaporizing water; and
 a discharging step for discharging water vapor, wherein the ice, the water, and the water vapor are regenerate in stages.

10 2. The water regeneration method according to claim 1, wherein each of the vaporizing step and the discharging step includes buildup determination.

15 3. The water regeneration method according to claim 1, wherein the temperature increasing step is a warm-up step for increasing a temperature of the portion of the case in which the ice is condensed to a melting point of the ice or higher to melt the ice.

20 4. The water regeneration method according to any one of claims 1 to 3, wherein the temperature increasing step is performed by one or more of temperature increase by a reverse rotation in which a motor of the refrigerator is rotated in an opposite direction to a rotation direction during cooling, temperature increase by purge in which a purge gas having a higher temperature than the melting point of the ice is made 25 to flow in the case to return a pressure in the case that is

kept vacuum to an atmospheric pressure and improve thermal conductivity with the outside of the case, and temperature increase by a heater.

5. The water regeneration method according to claim 1,
5 wherein, in the vaporizing step, water is vaporized by performing rough evacuation to reduce a pressure of the portion in which the water generated from melting of the ice by the temperature increasing step is accumulated within a range in which the temperature and the pressure of the portion 10 are prevented from reaching a freezing point of the water, the buildup determination for determining pressure increase by discharged moisture or a gas when the evacuation is stopped is performed, and the water vaporization and the buildup determination are repeated until the water vanishes away.

15 6. The water regeneration method according to claim 5,
wherein the pressure during the rough evacuation is set to 100 Pa to 200 Pa.

7. The water regeneration method according to claim 1,
wherein the discharging step is an evacuation step for 20 discharging the water vapor by further reducing the pressure by the rough evacuation at a time when the water is vaporized by the vaporizing step, performing the buildup determination to determine the pressure increase by a gas when the evacuation is stopped, and repeating the discharge of the 25 water vapor and the buildup determination until the pressure

increase is smaller than a value used for the determination.

8. The water regeneration method according to any one of claims 1, 3, and 4, wherein the temperature increasing step is switched to the vaporizing step at a time when the temperature 5 of the portion of the case in which the ice is condensed reaches the melting point of the ice.

9. The water regeneration method according to claim 5 or 6, wherein the vaporizing step is switched to the evacuation step based on the buildup determination using the discharged 10 moisture or gas when the evacuation is stopped.

10. A water regeneration apparatus for discharging ice condensed in a portion cooled by a cryogenic refrigerator installed in a case to an outside of the case, comprising:

temperature increasing means for increasing a temperature 15 of the portion in the case in which the ice is condensed to a melting point of the ice or higher to melt the ice;

vaporizing means for vaporizing water generated by melting of the ice by performing rough evacuation to reduce a pressure of the portion in which the water is accumulated 20 within a range in which the temperature and the pressure of the portion are prevented from reaching a freezing point of the water, performing buildup determination based on discharged moisture or gas when the evacuation is stopped, and repeating the water vaporization and the buildup determination 25 until the water vanishes away; and

evacuation means for discharging water vapor by further reducing the pressure at a time when the water is vaporized.

11. The water regeneration apparatus according to claim 10, wherein the temperature increasing means is achieved by 5 one or more of a reverse rotation of a motor of the refrigerator, a purge gas, and a heater.

12. A cryopump comprising the water regeneration apparatus according to claim 10 or 11.

13. A water trap comprising the water regeneration 10 apparatus according to claim 10 or 11.